ZOOLOGICAL SCIENCE **20**: 657–668 (2003)

A Marine Harpacticoid, *Quinquelaophonte koreana* sp. nov. from a Sandy Beach in Korea (Crustacea: Copepoda)

Wonchoel Lee*

Department of Life Science, College of Natural Sciences, Hanyang University, Seoul 133-791, Korea

ABSTRACT—A new interstitial copepod of the family Laophontidae was found in the samples from a sandy beach at Taean, west coast of Korea. This species was described and named as *Quinquelaophonte koreana* sp. nov. Present new species is clearly distinguishable from its congeners with the combined characters of the short caudal ramus and its short ornamented seta V, two setae on the antennary exopod, and small rounded rostrum. *Q. koreana* sp. nov. is the first record of *Quinquelaophonte* from the Northeast Asian coast.

Key words: *Quinquelaophonte koreana* sp. nov., Laophontidae, Harpacticoida, marine copepod, Korea

INTRODUCTION

The type species of the genus *Quinquelaophonte* Wells, Hicks & Coull, *Q, quinquespinosa*, was originally described by Sewell (1924) as *Laophonte quinquespinosa*, but was subsequently removed to the genus *Heterolaophonte* Lang by Lang (1944, 1948). Lang allocated this species to the *quinquespinosa*-group and later (Lang, 1965) claimed that this genus included several phylogenetic lineages and consequently deserved splitting up. A first step towards such a revision of *Heterolaophonte* was made by Wells *et al.* (1982), who proposed the genus *Quinquelaophonte* to accommodate species previously included in the *quinquespinosa*-group. The genus currently consists of seven species, including the problematic species *Laophonte brevicornis* Scott, 1894 (cf. Bodin, 1997).

Lang (1944, 1948) initially included three species in the *quinquespinosa*-group: *H. quinquespinosa* (Sewell, 1924), *H. sigmoides* (Willey, 1930) and *H. brevicornis* (Scott, 1894). *H. sigmoides* was later shown to be a junior subjective synonym of *H. quinquespinosa* by Hamond (1973) and Wells & Mckenzie (1973). Coull (1976) pointed out that *H. noncapillata* Lang, 1948 is a junior objective synonym for what should correctly be named *H. capillata* (Wilson, 1932) and transferred this species from the *discophora*-group to the *quinquespinosa*-group. Prior to its upgrading to genus level the latter group saw the addition of three new species: *H. longifurcata* Lang, 1965, *H. parasigmoides* Božić, 1969 and *H. wellsi* Hamond, 1973. A final species, *Q. candelabrum*, was added by Wells et al. (1982) when they diagnosed the genus *Quinquelaophonte*. They further questioned the status and position of *Laophonte brevicornis* and decided to place it as a *species incertae sedis* near or perhaps within the genus *Quinquelaophonte*. This assertion was based on the absence of males, which could have confirmed the sexually dimorphic genetic diagnostics, and on the enigmatic presence of an inner seta on the first exopod segment of P4. Both Lang (1948) and Candeias (1959) questioned the accuracy of Scott's (1894) observations since such a seta is not found in any other Laophontidae. Wells *et al.* (1982) on the other hand did not believe Scott had made an observational error since he had both figured (his plate 10, fig.35) and explicitly discussed the presence of this seta. Since Huys & Lee's (2000) analysis of the basal phylogeny of the Laophontidae it has now become clear that the presence of this element in *L. brevicornis* is extremely unlikely. The structure of the antennule, P5 and caudal rami in the female clearly justify its inclusion in the genus *Quinquelaophonte*. Fiers (1986) believed that *H. parasigmoides* fell within the range of variability displayed by *Q. quinquespinosa* but this requires confirmation by study of more specimens from more localities.

During a survey of the harpacticoid community along the west coast of Korea, a new species of *Quinquelaophonte* was collected from sandy beaches at Taean. The purpose of this paper is to provide an illustrated description of this species, and to discuss its relationships with other members of the genus.

* Corresponding author: Tel. +82-2-2290-0951;
FAX. +82-2-2296-7158.
E-mail: wlee@hanyang.ac.kr

MATERIALS AND METHODS

The specimens examined were collected by sieving sand at Taean on 15 June, 1992. Specimens were fixed with neutral formalin and preserved with 70% ethanol. Specimens were dissected in lactic acid and the dissected parts were mounted on slides in lactophenol mounting medium. Preparations were sealed with Glyceel or transparent nail varnish. All drawings have been prepared using a camera lucida on an Olympus BX51 or a Zeiss Axioskop differential interference contrast microscope.

The descriptive terminology is adopted from Huys *et al.* (1996). Abbreviations used in the text are: A1, antennule; A2, antenna; ae, aesthetasc; exp, exopod; enp, endopod; P1-P6, first to sixth thoracopod; exp(enp)-1(2, 3) to denote the proximal (middle, distal) segment of a ramus. Type series are deposited in the collections of The Natural History Museum, London (NHM). Scale bars in figures are indicated in μm.

DESCRIPTION

Family Laophontidae T. Scott, 1905

Genus *Quinquelaophonte* Wells, Hicks and Coull, 1982

Quinquelaophonte koreana sp. nov.

(Figs. 1–7)

Type locality. Sandy beach at Taean, west coast of Korea.

Material. Holotype (NHM 2003–119) 1 ♀ dissected on 9 slides. Paratypes 1 ♂ dissected on 9 slides (NHM 2003-120), and 1 ♀, 1 ♂, and 1 copepodite CV ♀ in 70% alcohol (NHM 2003-116-118). All specimens are from a sandy beach at Taean, west coast of Korea on 15 June 1992.

FEMALE (holotype)

Total body length 579–800 μm (mean=690 μm; n=2; measured from anterior margin of rostrum to posterior margin of caudal rami). Largest width measured at posterior margin of cephalic shield: 175 μm. Urosome gradually tapering posteriorly (Fig. 1A).

Cephalothorax with smooth posterior margin. Pleural areas well developed and rounded without lobate posterolateral angles. Entire surface covered with tiny spinules [indicated as dots] as illustrated in Fig. 1A-B. Sensillae and few pores present as illustrated in Fig. 1A-B. Rostrum small, round-shaped (Fig. 1A), completely fused to cephalosome, and with pair of sensillae near anterior margin.

Pedigerous somites covered with minute spinules. All prosomites without defined hyaline frills, and hind margin smooth. Body slightly constricted between individual somites.

Urosome (Fig. 1A–B) 5-segmented, comprising P5-bearing somite, genital double-somite and 3 free abdominal somites. All urosomites covered with small spinules dorsally and laterally. Ventral surface smooth and ventral hind margin with large spinules laterally and medially. Hyaline frills of urosomites not distinct.

Genital double-somite (Fig. 1A–B) with transverse, surface ridge dorsally and laterally, indicating original segmentation, and completely fused ventrally. Genital field located near anterior margin with very small copulatory pore located in median depression (Fig. 2A). P6 with small protuberance bearing 2 bare setae, outer seta longer than inner seta.

Anal somite (Fig. 1A) with smooth and thin operculum and flanked by pair of sensillae.

Caudal rami (Fig. 2B) short, cylindrical, 1.1 times longer than wide; each ramus with 7 setae: seta I bare, shortest, setae II and III bare, seta III longer than seta II, setae IV and V fused basally, distal half of seta V with tiny spinules on whole surface, and largest, seta VI pinnate and small, seta VII tri-articulate at base. Additional spinular ornamentation present along inner and outer margins and around ventral hind margin. Small pore present near ventral posterior margin.

Antennule (Fig. 2C) 6-segmented, with well developed sclerite around base of segment 1. Segment 1 with long spinules at distal anterior margin, and largest. Segment 2 without surface ornamentation or processes. Segment 4 with aesthetasc fused basally to 1 seta and set on distinct pedestal. Armature formula: 1–[1], 2-[8], 3–[6+1 pinnate spine], 4–[1+(1+ae)], 5–[1], 6–[6+2 pinnate spines + acrothek]. Apical acrothek consisting of small aesthetasc fused basally to 2 bare setae.

Antenna (Fig. 2D) 3-segmented, comprising coxa, allobasis and free 1-segmented endopod. Coxa small, and bare. Allobasis elongate; without distinct surface sutures marking original segmentation, with 1 tiny abexopodal pinnate seta in near distal margin [arrowed in Fig. 2D]. Exopod small, and Y-shaped with 2 tiny bare setae. Row of spinules along lateral margin posteriorly. Endopod subequal to allobasis in length and lateral armature arising in distal half, consisting of 2 strong bare spines. Apical armature consisting of 1 pinnate and 1 bare spines, and 3 geniculate setae (1 geniculate seta fused basally to short seta). Endopod with 2 rows of long spinules laterally and 1 transverse hyaline frills subapically.

Mandible (Fig. 2E) with well developed gnathobase bearing several multicuspidate teeth around distal margin. Palp small, endopod and exopod fused to basis, represented by small peduncles bearing 3 and 1 bare setae, respectively. Basal armature represented by 1 pinnate seta set on cylindrical process with rows of spinules laterally.

Maxillule and maxilla same as in male (Fig. 6B–C).

Maxilliped (Fig. 2F) with 1 pinnate and 1 small bare setae and several patches of spinules on syncoxa. Basis without rows of spinules along outer and inner margin. Endopod drawn out into long naked claw, with 1 short naked seta, and 1 tube pore.

Thoracic legs P1–P4 (Figs. 3A-B; 4A–B) with wide intercoxal sclerites and well developed praecoxae bearing row of spinules along distal margin. Coxae and bases with anterior rows of surface spinules as figured (except for P1). Exopods 3-segmented, endopods 2-segmented except P1. P1 exopod 2-segmented.

P1 (Fig. 3A). Coxa large, with several spinular rows and patches as figured. Basis with 1 strong, bipinnate spine on

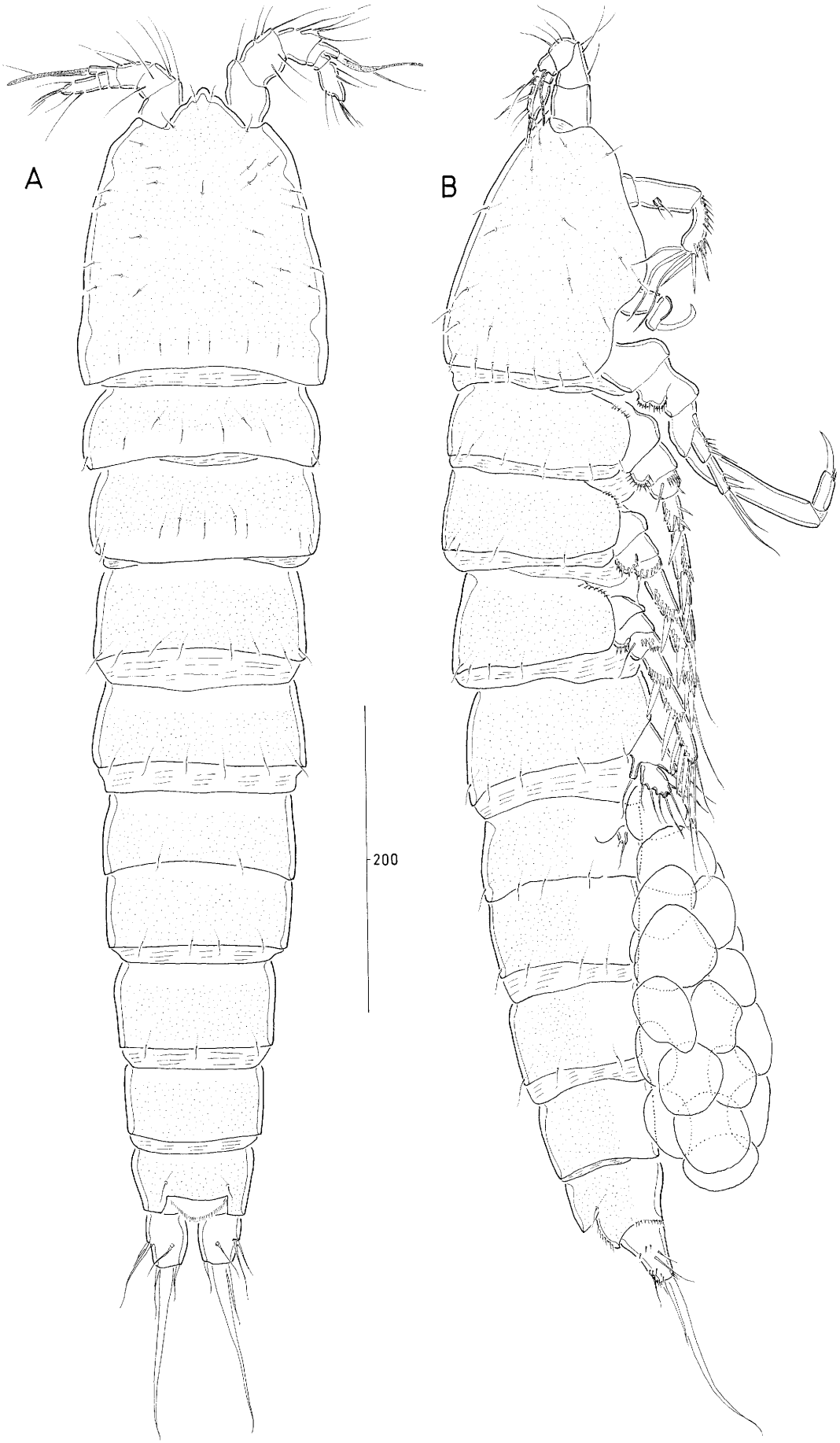

Fig. 1. *Quinquelaophonte koreana* sp. nov. Female (holotype): A, habitus, dorsal; B, habitus, lateral.

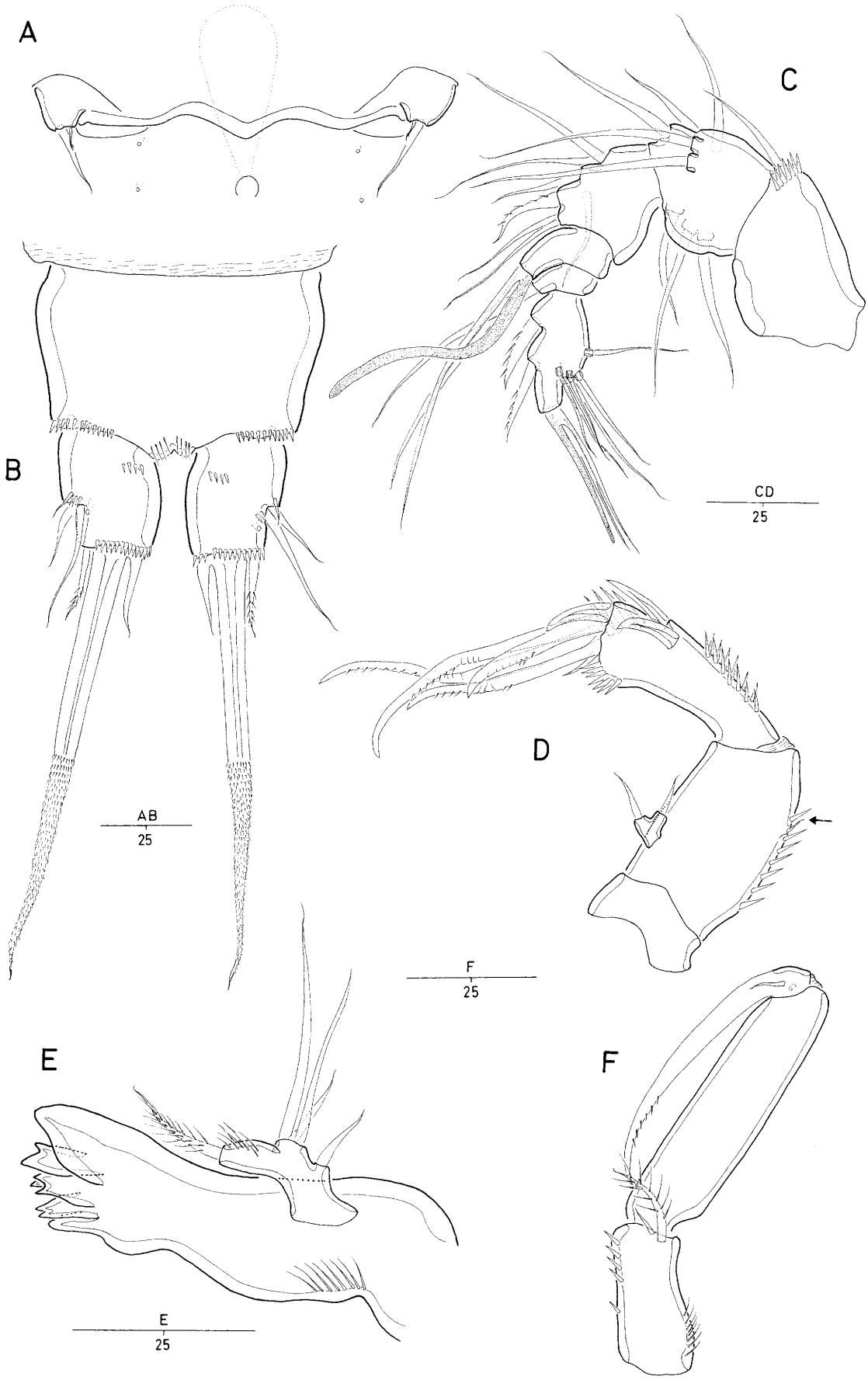

Fig. 2. *Quinquelaophonte koreana* sp. nov. Female (holotype): A, genital field; B, anal segment and caudal rami, ventral view; C, antennule; D, antenna; E, mandible: F, maxilliped.

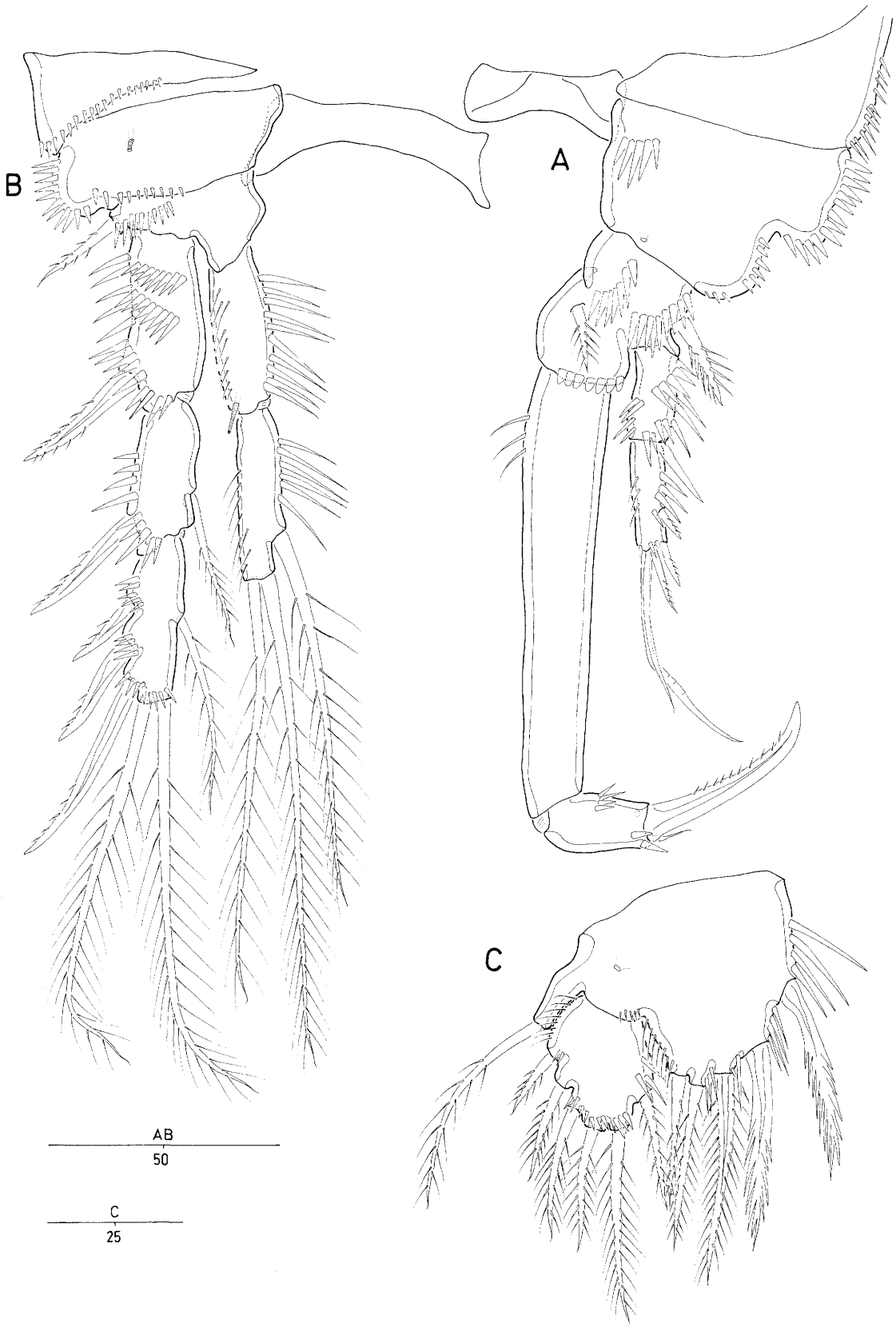

Fig. 3. *Quinquelaophonte koreana* sp. nov. Female (holotype): A, P1; B, P2; C, P5.

distal pedestal, long setules along inner margin, 1 stout bipinnate spine and spinules along outer margin, and 1 row of blunt teeth along near boundary with endopod. Anterior surface covered with spinules. Exopod small. Exp-1 with 1 unipinnate spine. Exp-2 with 3 pinnate spines and 2 geniculate setae. Enp-1 2 times as long as exopod, with long spinules along proximal inner margin. Enp-2 with 1 strong denticulate claw, and 1 small naked seta.

P2–P4 (Figs. 3B and 4A-B). Coxae and bases with spinular rows along outer margin and anterior surface. Basis

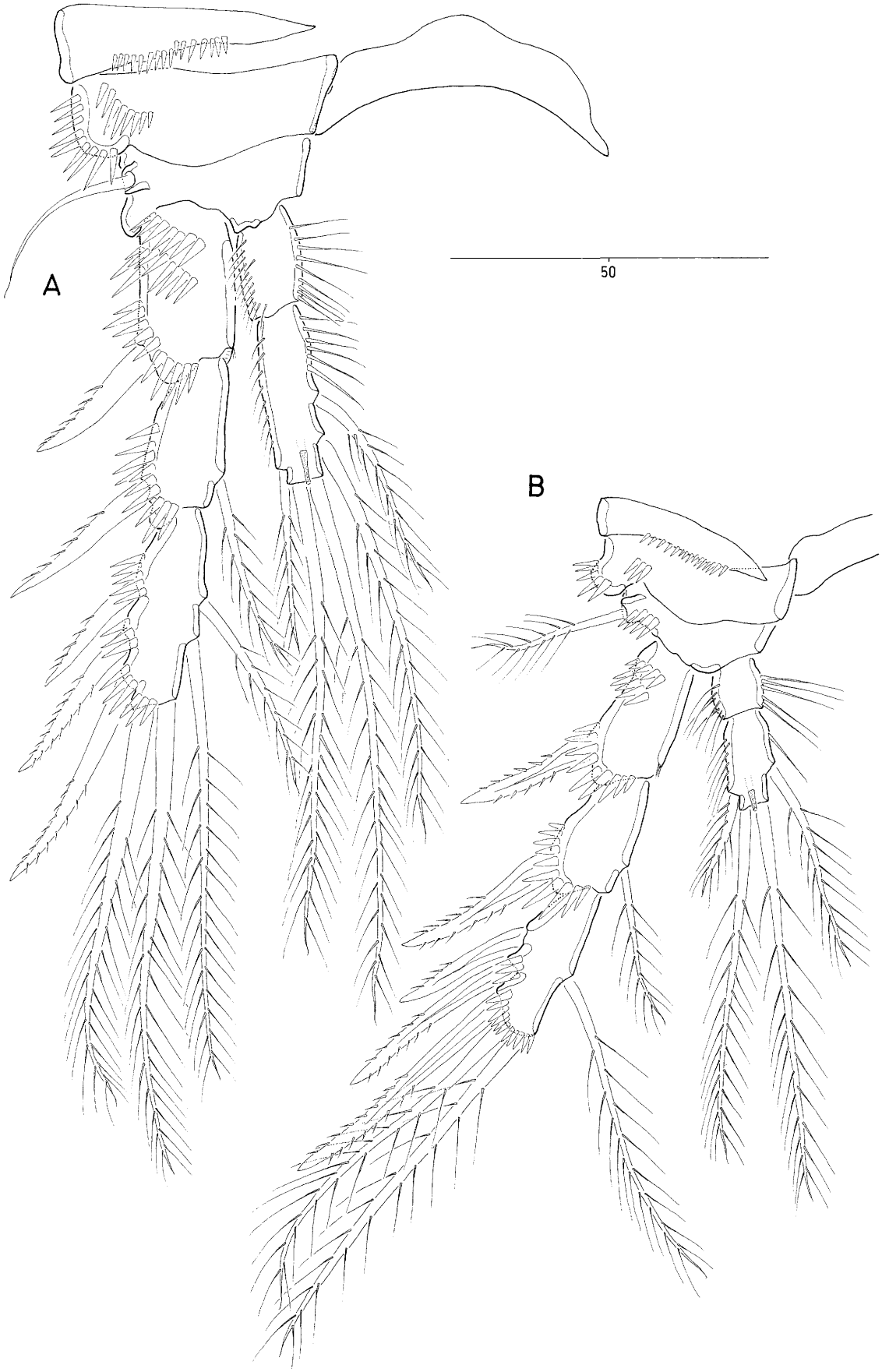

Fig. 4. *Quinquelaophonte koreana* sp. nov. Female (holotype): A, P3; B, P4.

with 1 tube pore on anterior surface. Outer margin of basis with bipinnate spine (P2) or seta (P3-P4). Each seta arising from short setophore in P3-P4. All segments with pattern of spinules as figured. Inner and outer margins of endopod segments with long setules or spinules. Tube pore present near distal margin of enp-1 in P2 and enp-2 in P3–P4. P2 enp-2 slightly longer than enp-1, endopod reaching to proximal area of exp-3, and Exp-1 longest. P3 enp-2 1.7 times longer than enp-1, endopod reaching to distal margin of exp-2, and exp-3 longer than exp-1. P4 smaller than P2 and P3, enp-2 1.7 times longer than enp-1, endopod reaching to middle of exp-2, and exp-3 slightly longer than exp-1. Spine and setal formulae as followings:

	Exopod	Endopod
P2	0.1.123	0.120
P3	0.1.223	0.221
P4	0.1.123	0.121

Fifth pair of legs (Fig. 3C) with separate exopod and baseoendopod, each covered with spinules as figured. Baseoendopod forming short, outer setophore bearing basal seta., and 1 pore near proximal area of setophore. Endopodal lobe not reaching to distal margin of exopod, with 3 pinnate setae, and 2 inner serrate spines. Exopod ovoid, about same length to width, with 6 pinnate setae, and each seta arising from distinct cylindrical process.

MALE (Paratype)

Body length 554–729 μm (mean=641 μm; n=2; measured from anterior margin of rostrum to posterior margin of caudal rami). Largest width measured at posterior margin of cephalic shield: 166 μm. Urosome distinctly narrower than prosome (Fig. 5A).

Prosome (Fig. 5A) 4-segmented, comprising cephalothorax and 3 free pedigerous somites. Cephalothorax with smooth posterior margin. Pleural areas well developed and rounded. Entire surface covered with tiny spinules as in ♀. Rostrum small, round-shaped (Fig. 5A), completely fused to cephalosome, and with pair of sensillae near anterior margin.

Pedigerous somites covered with minute spinules. All prosomites without defined hyaline frills. Hind margin smooth. Each pedigerous somite with smooth posterior margin. Body slightly constricted between individual somites.

Urosome (Fig. 5A) 6-segmented, comprising P5-bearing somite, genital somite and 4 abdominal somites. All urosomites with surface ornamentation consisting of small spinules dorsally and laterally, ventral surface smooth, and ventral hind margin with large spinules laterally and medially. Hyaline frills of urosomites not distinct.

Antennule (Fig. 5B–E) 8-segmented, and subchirocer with geniculation between segments 5 and 6. Segment 1 with 1 row of long spinules along outer distal margin. Segment 2 without processes on dorsal surface. Segment 4 represented by small sclerite along anterior margin (Fig. 5C). Segment 5 swollen. Segment 6 with spinular processes as in Fig. 5B, E. Segment 8 with triangular distal half. Segmental homologies: 1-I, 2-(II-VIII), 3-(IX-XII), 4-XIII, 5-(XIV-XX), 6-(XXI-XXII), 7-XXIII, 8-(XXIV-XXVIII). Armature formula: 1-[1], 2–[7+2 pinnate], 3–[6+1 pinnate], 4–[2], 5-[6+1 pinnate + 2 modified + (1+ ae)], 6-[2 spinous processes], 7–[1], 8–[7+ acrothek]. Apical acrothek consisting of minute aesthetasc and 2 naked setae.

Maxillule (Fig. 6B). Praecoxa with smooth outer margin. Arthrite strongly developed, with 8 spines/setae around distal margin. 1 row of long spinules on posterior surface. Coxa with cylindrical endite bearing 1 naked seta and 1 curved spine, and with several spinules around outer margin. Basis with cylindrical endite bearing 2 naked setae, and 1 curved, pinnate spine, and with several spinules on anterior surface. Endopod incorporated in basis, forming small peduncle with 3 naked setae. Exopod 1-segmented , with 2 naked setae.

Maxilla (Fig. 6C). Syncoxa with 3 endites. Praecoxal endite small and cylindrical, with 1 strong, pinnate spine. Proximal coxal endite with cylindrical with 3 pinnate spines. Distal coxal endite with 1 pinnate and 2 naked setae. Allobasis drawn out into strong, slightly curved, distally pinnate claw; accessory armature consisting of 2 naked setae on anterior surface, and 1 naked seta on posterior surface. Endopod represented by 2 naked setae.

P2–P4 (Fig. 6D, 7A-B). Intercoxal sclerites and protopods as in ♀ , without surface ornamentation as figured. Exopods, and Endopods of P2 and P3 with sexual dimorphism. Inner setae of P2 exopod (Fig. 7A) distinctly shorter than in ♀ . Inner distal seta of P2 exp-3 reduced, and modified to pinnate spine, and outer distal seta shorter and thicker than in ♀ . Setae on P2 enp-2 shorter than in ♀ . P3 exopod (Fig. 7B) distinctly bent inwards, exp-1 shorter than exp-3, and outer and distal spines of exopod thicker than in ♀ . Inner setae of P3 exopod distinctly shorter than in ♀ . Setae on P3 enp-2 shorter than in ♀ . Inner setae of P4 exopod (Fig. 6D) distinctly shorter than in ♀ , exp-1 longer than exp-3, and outer spines of exp-2 and -3 and distal spine of exp-3 thicker than in ♀ . Setae on P4 enp-2 shorter than in ♀ .

Exopod and bseoendopod of P5 (Fig. 6A) fused, and forming one plate with 2 pinnate spines, 2 pinnate setae, and small setophore bearing outer basal seta. Inner pinnate spine shortest.

Sixth pair of legs (Fig. 6A) asymmetrical, represented on both sides by small plate (fused to ventral wall of supporting somite along one side, articulating at base, and covering gonopore along one side). Outer distal corner produced into short process bearing 1 bipinnate inner spine and 1 pinnate outer seta. Outer seta arising from short setophore.

Etymology. The specific name *koreana* is taken from its type locality, Republic of Korea.

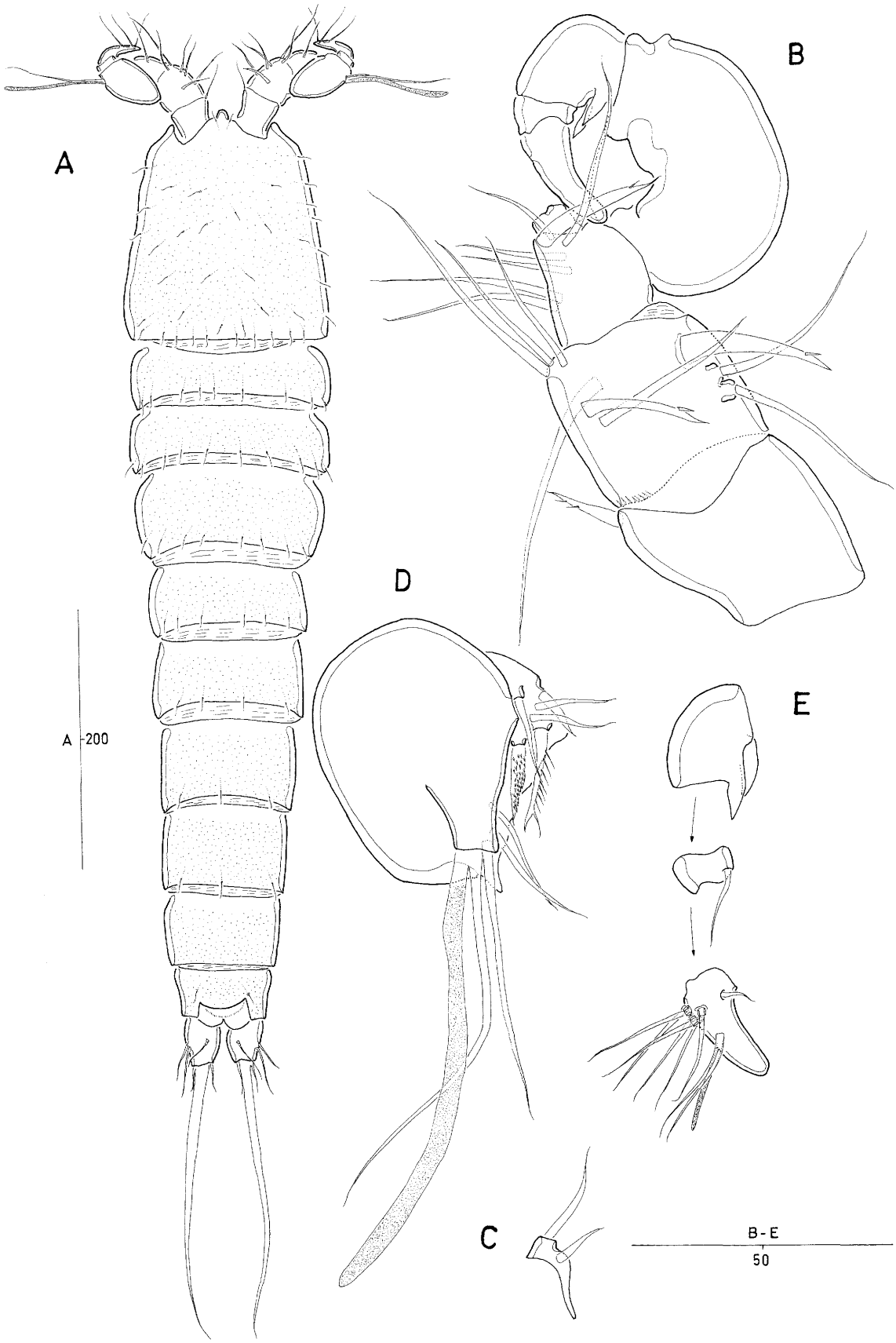

Fig. 5. *Quinquelaophonte koreana* sp. nov. Male (paratype): A, habitus, dorsal; B, Antennule [armature omitted from segments 4–7]; C, antennular segment 4; D, antennular segment 5; E, antennular segments 6–8.

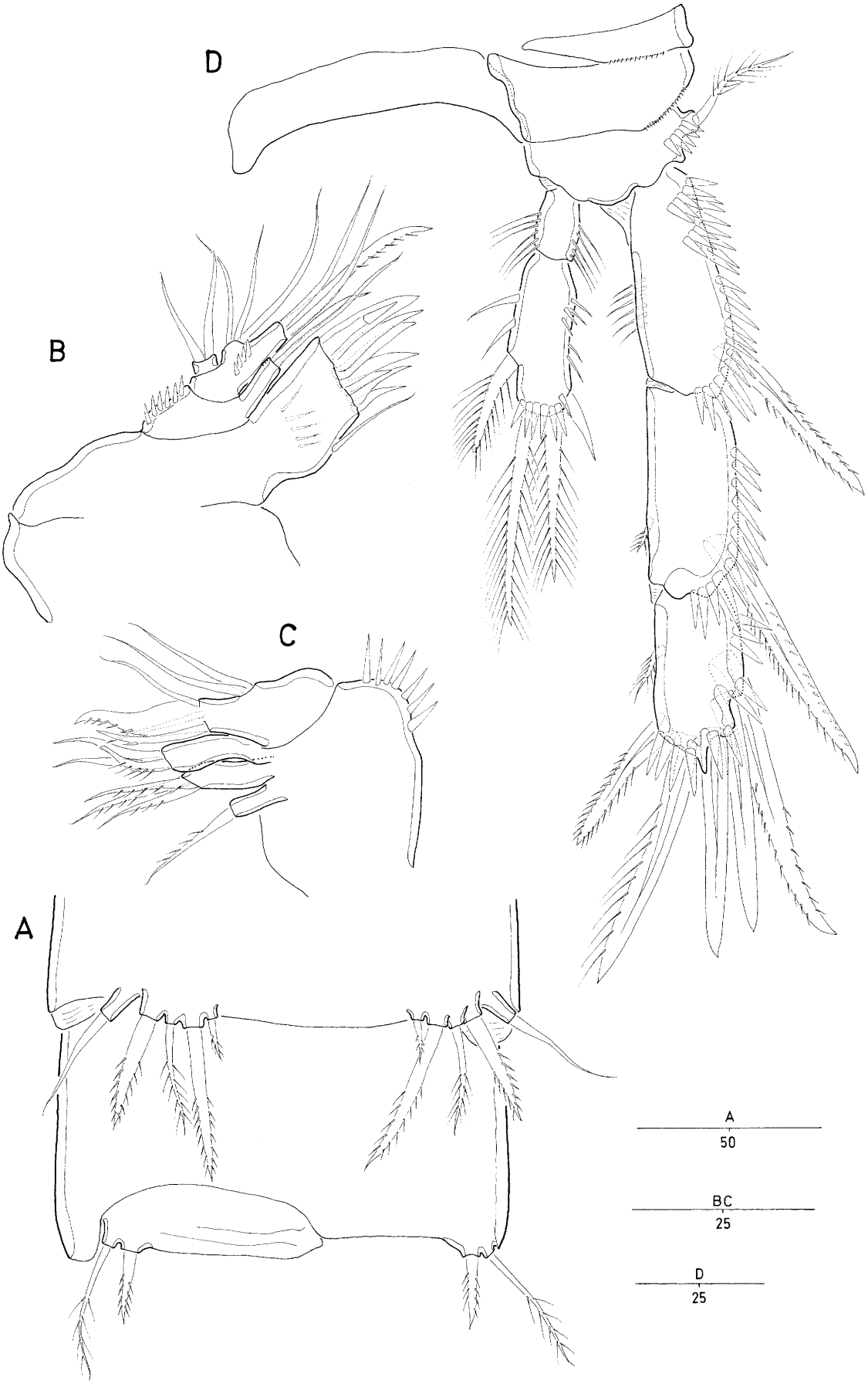

Fig. 6. *Quinquelaophonte koreana* sp. nov. Male (paratype): A, P5 and P6; B, Maxillule; C, maxilla; D, P4.

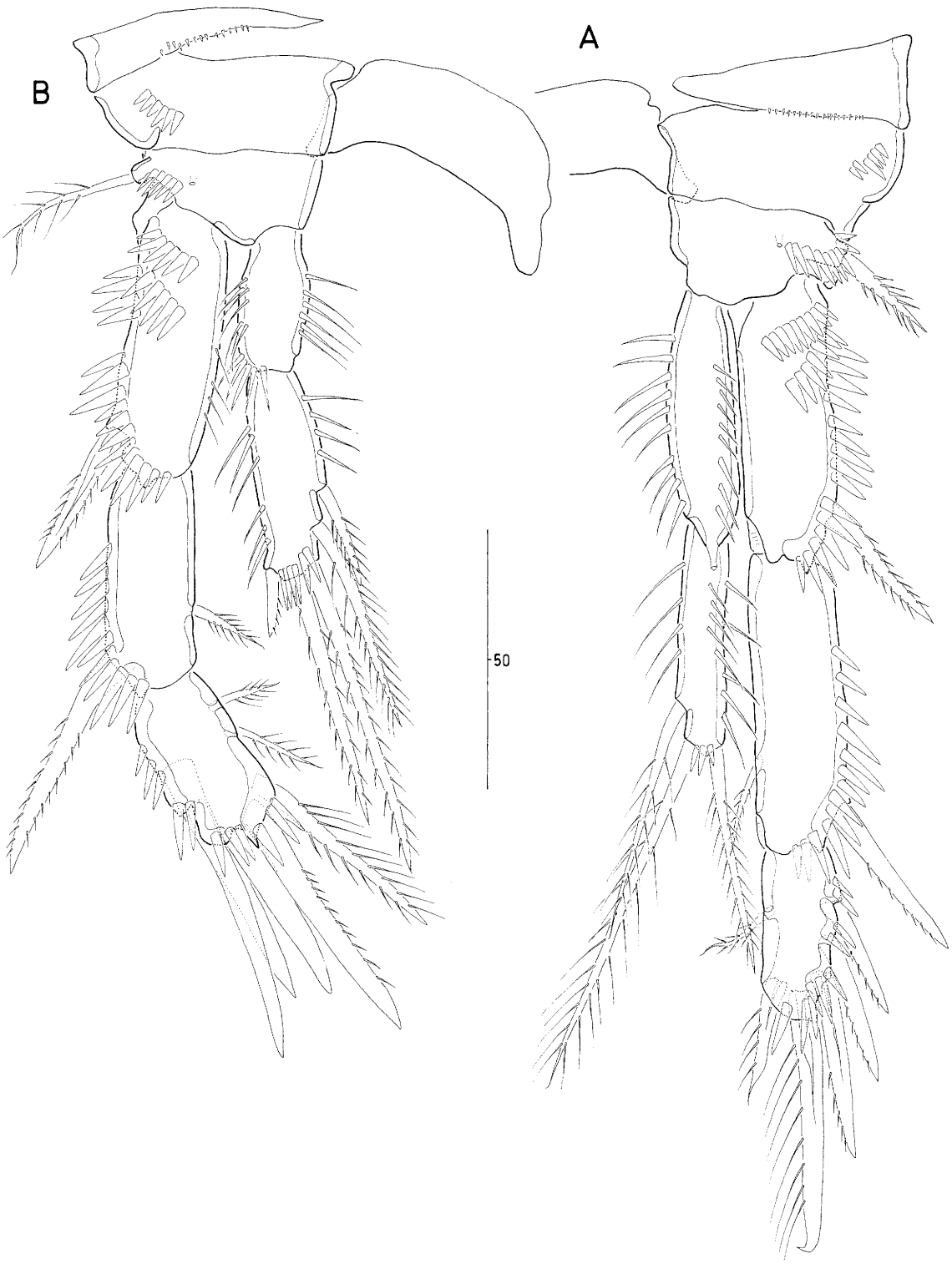

Fig. 7. *Quinquelaophonte koreana* sp. nov. Male (paratype): A, P2; B, P3.

DISCUSSION

The new species is placed in the genus *Quinquelaophonte* on account of the 6-segmented female antennule, reduced antennary exopod, caudal rami with a single well developed terminal seta (V), broad female P5 baseoendopod, unmodified male P2 endopod, sexually dimorphic P2-P4 exopods and reduced male P5 represented by five arising from the somatic margin.

Using Wells *et al.*'s (1982) key to species, *Quinquelaophonte koreana* appears to be most closely related to *Q. quinquespinosa* (Sewell, 1924), the type species of the genus. The close relationship between both species is indicated by the following combination of shared character states: (1) 6-segmented female antennule, (2) presence of six setae on the female P5 exopod, (3) male P5 represented

by five setae, (4) P1 enp-2 with accessory seta markedly shorter than claw, and (5) P3 exp-3 with seven setae/spines.

Although the armature formula of legs 2–4 in *Q. koreana* is identical to that of *Q. quinquespinosa*, both species can be easily distinguished on the basis of caudal ramus length (slightly longer than wide in *Q. koreana*, more than twice as long as wide in *Q. quinquespinosa*) and the P1 exopod being distinctly shorter in the former.

A careful comparison with *Q. quinquespinosa* is however difficult since this species is allegedly cosmopolitan and individual populations are known to differ in a number of characters (Table 1). For example, widely disjunct populations differ in the armature of the antennary exopod, P4 and female P5, as well as in the length/width ratio of the caudal ramus and P1 exopod. Huys & Lee (2000) recently showed that *Esola longicauda* Edwards, 1891 in reality represents a complex of closely related species rather than a single widely distributed variable species. It is conceivable that *Q. quinquespinosa* is yet another example of such a species complex within the Laophontidae and that eventually many of its so-called "population" will be recognized as distinct species. Such delimitation of morphologically distinct taxa with the *quinquespinosa* complex is at present impossible since intraspecific variability within geographically isolated populations has not been examined in detail and most illustrated records were based on very few specimens. In addition, many descriptions are incomplete and lack sufficient detailed information on the armature and ornamentation of individual appendages.

Q. quinquespinosa was originally described from Chilka Lake, India. There is some confusion concerning the precise armature of the antennary exopod in this species since Sewell (1924) illustrated three setae in his drawing but mentioned four in the text description. Hamond (1973) also failed to reveal the correct armature of this ramus and it is difficult to identify the precise number of elements in his description (his Fig. 32 on p. 404). Similar uncertainty exists concerning the armature of the female P5 exopod. Gurney (1927) reported a variation in a specimen from the Suez Canal, indicating the presence of an additional inner seta. It is difficult to interpret this difference since small spinules or setules are always present at the inner distal corner of the female P5 exopod (e.g. Fig. 3C). It is conceivable that the supernumerary seta figured by Gurney (1927) represents one of the spinules usually found in this position rather than a genuine seta, although both Willey (1930) and Candeias (1959) have reported a similar additional element in their material from Bermuda and Angola, respectively. I cannot be ruled out that differences like these represent intraspecific variability since at least Gurney (1927) and Candeias (1959) had only a single specimen at their disposal.

Monard (1935) claimed that his specimens agreed well with Sewell's (1924) original description, however, the Tunisian material has a slightly longer caudal ramus, a third antennulary segment that is slightly shorter and a different P4. Unfortunately Monard's (1935) statements were not accompanied by any illustrations.

Por (1973) reported *H. quinquespinosa* from the Sirbonian Lagoon and revealed a unique sexually dimorphic outer spine on the distal segment of the P3 endopod which is undoubtedly homologous with the sharp process illustrated by Sewell (1924) and Wells & McKenzie (1973). Por (1973) also claimed that the bulbous shape of caudal ramus seta V is a deformation caused by fungal parasites. It is unlikely that this is correct since modified caudal ramus setae are typically found in females only, suggesting that they play a role in the key-and-lock mechanism with the male antennules during precopulatory mate guarding. Within *Quinquelaophonte* this sexual dimorphism is most pronounced in *Q. candelabrum* where females display "pipette-shaped" setae.

It is clear that several species hide under the name *Q. quinquespinosa* but that specific identification is at present hampered by the lack of reliable descriptions and sufficient material. One exception is *Q. quinquespinosa bunakenensis* described by Mielke (1997) from Sulawesi, Indonesia. As pointed out by Mielke the Indonesian material differs from Sewell's (1924) type material in several meristic characters

Table 1. Taxonomically important characters of the previously regarded species as *Quinquelaophonte quinquespinosa*.

		A2 Exp., no. of setae	Ratio of P1 exp. exp2/exp1	P4, no. of setae Exp3	P4, no. of setae Enp2	CR Ratio (L : W)	Setal no. P5 exp.	Locality
quinquespinosa	Sewell (1924)	3 (4)	2.3	–	1.2.0	2.6	6	Chilka lake
quinquespinosa	Gurney (1927)	3 (4)	2.3	–	1.2.0	2.6	7	Suez canal
sigmoides	Willey (1930)	–	–	2.2.3	1.2.0	3.0	7	Bermuda
quinquespinosa	Candeias (1959)	–	1.6	–	–	2.2	7	Angola
sigmoides	Hamond (1973)	2	1.6	2.2.3	1.2.1	3.0	6	Marseille
quinquespinosa	Wells & Mckenzie (1973)	2	2.0	1.2.3	1.2.1	2.5	6	Aldabra
quinquespinosa	Por (1973)	3	1.8	2.2.3	1.2.0	2.3	6	Sirbonian Lagoon
quinquespinosa bunakenensis	Mielke (1997)	3	1.3	1.2.3	1.2.0	2.2	6	Sulawesi
koreana	**present study**	**2**	**1.1**	**1.2.3**	**1.2.1**	**1.0**	**6**	**Taean**

such as the proportional length of the distal endopod segment in the male P4, the size of the P1 exopod and the female P5 exopod. Mielke's (1997) specimens also differ from all other species in the genus by the absence of an outer spine/seta on P3 enp-2 in the female (and consequently a pointed process in the male). The combination of these characters is regarded here as sufficient evidence warranting the upgrade of *Q. quinquespinosa bunakenensis* to full species status.

Although the diagnostic characters of *Q. quinquespinosa* are not yet fully documented, there is no doubt that *Q. koreana* is a distinct species. It appears that the new species is most closely related to the Aldabra Atoll species identified by Wells & McKenzie (1973) as *H. quinquespinosa*. They display identical setal formulae on the swimming legs and share the same number of exopodal setae on the antenna. However, distinct differences can be found in the P1 exopod, P5 exopod and caudal ramus. The P5 exopod of *Q. koreana* has an ovoid shape which is unique within the genus. The new species also has the shortest distal segment of P1 exopod and the shortest caudal ramus of all species currently recognized in *Quinquelaophonte*.

ACKNOWLEDGEMENTS

This work was supported by Korea Science and Engineering Foundation (R01-2002-000-00081-2002). The author also acknowledges financial support from the Natural Science Institute, Hanyang University provided for the program year 2001 and thanks Ms Young Hee Song, Ms. Eun Jung Nam, and Mr. Hyun Woo Bang (Hanyang University) for their help during the preparation of the manuscript. The author would like to thank Dr Rony Huys of The Natural History Museum, London, and an anonymous reviewer for their valuable comment on the manuscript.

REFERENCES

Bodin P (1997) Catalogue of the new marine harpacticoid copepods. Studiedocumenten van het KBIN 89: 1–304

Božić B (1969) Copépodes Harpacticoïdes de la Réunion, Bull Mus Natn Hist Nat Paris 36: 481–499

Candeias A (1959) Contribution to the knowledge of the Harpacticoid (Crustacea, Copepoda) from the littoral of Angola. Publ Cult Comp Diam Angola, Lisbon, 45: 77–104

Coull BC (1976) On the two laophontid harpacticoid copepods described by Wilson as *Laophonte capillata*, with keys to the genus *Paronychocamptus*. Trans Amer microsc Soc 95: 35–45

Fiers F (1986) Harpacticoid copepods from the West Indian Islands: Laophontidae (Copepoda, Harpacticoida). Bijdr Dierk 56: 132–164

Gurney R (1927) Zoological results of the Cambridge expedition to the Suez Canal, 1924 23. Report on the Crustacea-Copepoda (littoral and semi-parasitic). Trans Zool Soc London 22: 451–577

Hamond R (1973) The harpacticoid copepods (Crustacea) of the saline lakes in southeast Australia, with special reference to the Laophontidae. Records Australian Mus 28: 393–420

Huys R, Gee JM, Moore CG, Hamond R (1996) Marine and brackish water harpacticoid copepods. Part 1. Synopses of the British Fauna (New Series) 51, Field Studies Council, Shrewsbury

Huys R, Lee W (2000). Basal resolution of laophontid phylogeny and paraphyly of Esola Edwards. Bull Nat Hist Mus Lond (Zool) 66: 49–107

Lang K (1944). Monographie der Harpacticiden (Vorläufige Mitteilung). Almqvist & Wiksells Boktryckeri Ab, Uppsala: 1–39

Lang K (1948) Monographie der Harpacticiden. Håkan Ohlsson, Lund

Lang K (1965) Copepoda Harpacticoida from the Californian Pacific coast. Kungl Svenska Vetenskaps Handl 10: 1–560

Mielke W (1997) On a small collection of Laophontidae (Copepoda) from Sulawesi, Indonesia. Microfauna Marina 11: 223–250

Monard A (1935) Les Harpacticoides marins de la région de Salammbô. Bull Stn Océanogr Salammbô 34: 1–94

Por FD (1973) The benthic Copepoda of the Sirbonian lagoon (Sabkhat El Bardawil). Cah Biol Mar 14: 89–107

Scott T (1893) Report on Entomostraca from the Gulf of Guinea, collected by John Rattray, B.Sc. Trans Linnean Soc London (Zool) 6: 1–161

Sewell RBS (1924) Crustacea Copepoda. In: Fauna of Chilka Lake. Mem Ind Mus 5: 771–851

Wells JBJ, Hicks GRF, Coull BC (1982) Common harpacticoid copepods from New Zealand harbours and estuaries. New Zeal J Zool 9: 151–184

Wells JBJ, McKenzie KG (1973) Report on a small collection of benthic copepods from marine and brackish waters of Aldabra, Indian Ocean. Crustaceana 25: 133–146

Willey A (1930) Copepod phenology – observations based on new material from Canada and Bermuda. Archo Zool Ital 16: 601–617

(Received August 12, 2002 / Accepted February 20, 2003)